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# Health-related quality of life among transgender and gender expansive youth at a rural gender wellness clinic

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## Abstract

**Purpose** To address a critical gap in the existing Health-Related Quality of Life (HRQOL) literature by quantifying and describing HRQOL among transgender and gender expansive (TG/GE) youth at a rural gender clinic and comparing the HRQOL of these youth to age-stratified United States (U.S.) population standards.

**Methods** This cross-sectional study includes results of the baseline HRQOL assessment of 141 TG/GE patients enrolled in the Gender Wellness Center (GWC) Pediatric Patient Registry. HRQOL was assessed using the Child Health Questionnaire-Child Form 87 (CHQ-CF87; ages < 18) and the Short Form-36 (SF-36v2; ages 18–21). Mean subscale scores were compared to the most current U.S. population standards available.

**Results** On all but one of the CHQ-CF87 subscales, TG/GE youth scored significantly lower than 2015–2016 U.S. general population youth and youth with two chronic conditions. On the SF-36v2, TG/GE youth scored significantly higher than 2009 U.S. standards on all physical health domains but lower on all but one of the mental health domains.

**Conclusions** Cross-sectional HRQOL data from a registry of TG/GE youth indicate significantly poorer mental health measures as compared with the U.S. general population. Longitudinal assessments are needed to evaluate whether HRQOL improves with gender-affirming care. Future studies should aim to identify sociocultural factors at the intersection of rurality and health that contribute to diminished HRQOL among rural TG/GE youth.

**Keywords** Quality of life · Adolescent · Pediatric · Transgender · Anxiety · Mental health

## Introduction

The World Health Organization (WHO) defines health-related quality of life (HRQOL) as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, values and concerns" [1]. HRQOL is a multidimensional construct of well-being [2, 3] that incorporates physical, mental, social, behavioral, and environmental determinants of health, and can provide insight into the specific healthcare needs and impediments to well-being affecting a population. The existing body of evidence on the HRQOL of transgender (TG) persons in the United States is largely limited to adult populations with few pediatric studies available. A thorough review of the extant literature identified only three studies published to date in which HRQOL was evaluated as a primary outcome of interest using a standardized, validated HRQOL assessment in a pediatric TG population [4–6].

Zou et al. assessed HRQOL among transgender and gender nonconforming (TGN) youth ($N = 142$; age range: 6–23) at an outpatient clinic in the United States using the PEDSQL 4.0 Generic Core Scales [4]. The PEDSQL Generic Core Scales measure physical, emotional, social, and school functioning [7]. Scores for TGN youth were compared with

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published scores for healthy adolescents and adolescents with chronic diseases including diabetes, gastrointestinal conditions, cardiac conditions, asthma, obesity, end-stage renal disease, psychiatric disorders, cancer, rheumatologic conditions, and cerebral palsy [8]. HRQOL was significantly lower (more than twice the clinically meaningful difference) among TGN youth compared to healthy controls. TGN youth also scored significantly lower than adolescents across the chronic disease comparison groups, with the exception of the rheumatology and cerebral palsy samples.

Roder et al. evaluated HRQOL among adolescents who were clinically referred for gender dysphoria ($N = 126$; age range: 11–18) at a Gender Identity Service in Germany [5]. The KIDSCREEN-27, which has five scales (physical well-being, psychological well-being, parent relations and autonomy, social support and peers, and school) was used to assess HRQOL [9]. The authors documented diminished HRQOL (particularly regarding psychological and physical well-being) in the sample compared to the age-matched European reference norm. High levels of internalizing problems (i.e., depression, social withdrawal, anxiety) and low levels of body satisfaction predicted low HRQOL.

The only longitudinal HRQOL study of TG youth to date was conducted in the Netherlands. De Vries et al. evaluated psychological functioning, objective well-being, and subjective well-being (including quality of life (QOL)) in a small sample of TG young adults ($N = 55$) who had received puberty suppression during adolescence [6]. Youth were assessed at baseline (prior to puberty suppression (mean age: 13.6 years), at hormone initiation (mean age: 16.7 years), and at least 1-year post-gender-affirming surgery (mean age: 20.7 years) using the World Health Organization's QOL measure (WHOQOL-BREF) [10]. This measure assesses physical and psychological health, social relationships, and environment. WHOQOL-BREF scores for TG youth were compared to results of published validation and reliability studies. A further analysis was performed to test if residual change scores for the fourteen indicators (of gender dysphoria, body image, and psychological functioning) evaluated over time were correlated with QOL indicators. The authors found that gender-affirming medical care alleviated gender dysphoria and improved psychological functioning. QOL scores for TG young adults were not significantly different from the comparison samples. Residual change scores for the following indicators were significantly correlated with QOL indicators: secondary sex characteristics, global functioning, depression, anger, anxiety, and Youth Self-Report (YSR) total, internalizing and externalizing scale scores [11].

TG youth face barriers to healthcare and are at high risk for poor medical and psychosocial outcomes related to gender dysphoria and chronic minority stress [12–14]. Past research indicates that levels of psychopathology and psychiatric disorders are higher in TG populations compared to cisgender populations in the absence of gender-affirming medical care [15]. Gender-affirming medical care includes puberty suppression, gender-affirming hormone therapy (GAHT) and surgical procedures which have been associated with alleviation of gender dysphoria and improved mental health among adults [15, 16]. HRQOL assessments have previously been used to evaluate outcomes of gender-affirming medical care including GAHT [17–19] and surgery [20–28] among TG adults, but the evidence base on HRQOL of TG youth is lacking. Learning about young TG patients' self-perceived physical and mental health can identify healthcare needs specific to this population.

The objectives of this study were to (1) address a critical gap in the existing literature on HRQOL among transgender and gender expansive (TG/GE) youth; (2) quantify and describe HRQOL of TG/GE youth enrolled in a pediatric registry at a rural gender clinic; and (3) compare the HRQOL of these youth to age-stratified United States population standards. Rural areas in the U.S. are typically underserved in terms of clinical care, which may augment the health disparities affecting TG/GE youth [29]. To our knowledge, this study is the first to evaluate HRQOL among TG/GE youth in a rural clinic setting and only the second study to assess HRQOL in a TG/GE pediatric population in the United States as a primary outcome using standardized, validated tools.

## Rural setting

The Gender Wellness Center (GWC) of the Bassett Healthcare Network is a "nationally recognized, rural-based, multidisciplinary center that offers gender-affirming medical, psychological, and surgical care to TG/GE youth and adults in Upstate New York" [30]. We established a pediatric patient registry at the GWC in 2017 in order to "(1) enable systematic, in-depth study (descriptive, retrospective, and prospective longitudinal) of the pediatric patient population served by the GWC, (2) enhance understanding of the healthcare needs of TG/GE youth (including physical, mental, and social health and well-being), and (3) contribute to and fill gaps in the existing evidence base on best clinical practices in gender care" [30]. The process and methodology by which the registry was established has been published previously [30].

The catchment area of the GWC registry encompasses 30 counties across New York State [30]. Nearly half of patients enrolled in the registry reside in rural zip code areas (defined as a zip code with a population < 10,000) [30]. Approximately 21% of cities and towns in which registry subjects reside have a population < 2500, 36% have a population < 5000, and 51% have a population < 10,000 [30]. The GWC itself is located in Otsego County, which encompasses

1015 square miles and had a population of < 60,000 as of 2018 [31]. The county is described as rural, with "dairy farming a contributing industry" on the official website of New York State [31].

## Methods

### Standard protocol approvals, registrations, and patient consents

Study procedures were approved by the Mary Imogene Bassett Hospital Institutional Review Board. All subjects or legally authorized representatives provided informed consent to participate in the GWC registry [30]. A parent or legal guardian provided informed consent for all patients < 18 years of age; patients are reconsented upon reaching the age of majority. Verbal assent was also obtained from youth < 18 years of age. Youth ages 18–21 provided informed consent as legal adults.

### Subject population and recruitment

All pediatric patients (defined as < 25 years of age) receiving gender-affirming care at the GWC are eligible for inclusion in the clinic's registry [30]. We approach prospective participants on site at the end of scheduled clinic appointments. The patient's clinician initiates the recruitment process, after which the patient (and legally authorized representative, if applicable) is approached for consent by a study coordinator. The subject is subsequently assigned a research number, enrolled in the registry, and completes baseline demographic and HRQOL questionnaires.

Demographic variables including age at registry enrollment, age at clinic presentation, assigned sex at birth, gender identity, race, ethnicity, and education level were derived from patients' electronic medical records (EMR). Missing information was filled in using data collected on the demographics survey administered at registry enrollment. Zip codes and United States Census data were utilized to designate patient residences as rural or non-rural [32, 33]. A rural area was defined in this study as a zip code with a population < 10,000.

### HRQOL measurement

A baseline HRQOL assessment is administered at the time of registry enrollment. HRQOL is evaluated using the Child Health Questionnaire-Child Form 87 (CHQ-CF87) [34, 35] for youth < 18 years of age and the Short Form-36 version 2 (SF-36v2) [36, 37] for youth ages 18–21. The reliability and validity of these surveys has been well documented; indeed, the SF-36 is reportedly the most frequently used patient reported outcomes instrument in clinical trials [35, 38]. The CHQ-CF87 is a child-report form consisting of 87 items that cover 14 physical and psychosocial domains (Table 1). The SF-36 was developed by the RAND Corporation as part of the Medical Outcomes Study and measures physical and

**Table 1** Domains of HRQOL assessed by the Child Health Questionnaire-Child Form 87 (CHQ-CH87)

| Domain | Description |
|---|---|
| General health perceptions | Assesses self-perceived general health status |
| Physical functioning | Assesses difficulty participating in activities due to physical health problems |
| Role/social physical functioning | Assesses difficulty performing schoolwork and engaging in social activities due to physical health problems |
| Bodily pain | Assesses bodily pain and discomfort |
| Role/social emotional functioning | Assesses difficulty participating in activities due to emotional problems (i.e., feeling sad) |
| Role/social Behavioral functioning | Assesses behaviors, moods, and interactions with authority figures |
| Parent impact-time[a] | Assesses the impact of the child's health on the parent's time |
| Parent impact-emotional[a] | Assesses the level of parental concern about and emotional impact of the child's health on the parent |
| Self-esteem | Assesses respondent's feelings about friendships, social environment, and others' perceptions |
| Mental health | Assesses frequency of feelings of sadness, fear, worry and happiness, and symptoms of mental health problems |
| Behavior | Assesses behaviors relative to children of the same age |
| Family activities | Assesses the impact of the respondent's health and behavior on family activity restrictions |
| Family cohesion | Assesses general family dynamics |
| Change in health | Assesses perceived health status relative to 1 year prior |

The CHQ-CF87 is an 87-item self-report measure of HRQOL. Response options are ordinal scales; scores are transformed to a 0–100 scale (mean: 50; SD: ± 10) with higher scores representing better QOL

[a]Two of the 14 domains of the CHQ were not evaluated in this sample because the study utilized the child-report form (CHQ-CF87) only, and not the parent-proxy reports, which include the domains "Parent Impact-Time" and "Parent Impact-Emotional"

mental health across eight domains and a total of 36 questions (Table 2). Neither scale includes TG-specific questions, but both provide a global assessment of patient-perceived HRQOL that can be compared to U.S. population standards. Licenses were obtained for the use of both surveys.

### Statistical analysis

Demographic characteristics of the sample were summarized using appropriate summary statistics for continuous and categorical variables (Table 1). For the CHQ-CF87, comparison to 2015–2016 U.S. population standards was carried out using one-sample z-tests. CHQ-CF87 scores were also compared to scores of youth with two chronic conditions. For the SF-36v2, comparison to 2009 U.S. population standards was accomplished using two-sample *t* tests. The Satterthwaite approximation was used to pool the standard deviation and adjust degrees of freedom of the test in the event of unequal variance.

## Results

### Enrollment and survey completion

Of TG/GE youth receiving care at the GWC, 158 were enrolled in the Registry by January 1, 2019 (97% recruitment rate). The HRQOL survey completion rate at baseline for all patients enrolled in the registry was 89% ($N = 141$). Baseline HRQOL assessments began approximately 1 month after registry recruitment was initiated; therefore, baseline HRQOL results are not available for the first patients enrolled in the registry ($n = 17$). A total of 74 youth ages 8–17 completed the CHQ-CF87 and 67 youth ages 18–21 completed the SF-36v2.

### Demographic characteristics of the sample

Ninety-two percent of participants were white, 93% non-Hispanic, and 49% reported attending school (grade range 3–12) (Table 3). Among youth who were out of school, 63% were pursing higher education. The racial and ethnic profile of the sample is consistent with that of the Upstate New York region and Otsego County, where the GWC is located. Otsego County, NY, is 94% white and 96% non-Hispanic [39]. The average age at enrollment was 17.1 (± 3.2; range: 8–21), and average age at clinic presentation was 16.3 (± 3.2). Seventy-one percent of youth were assigned females at birth. Two-thirds (67%) identified on the transmasculine spectrum, 26% identified on the transfeminine spectrum, and 6% identified as non-binary or gender nonconforming.

### Child Health Questionnaire-Child Form 87 (CHQ-CF87)

TG/GE youth scored significantly lower than 2015–2016 U.S. population standards (for youth ages 8–17) and youth with two chronic conditions (Table 4, Fig. 1). The greatest disparities between TG/GE youth and the U.S. population standards were observed on the mental health subscales including role/social limitations—emotional (compared to U.S. general population standard: z-score: − 8.04, $p < 0.0001$; compared to youth with two chronic conditions: z-score: − 9.56; $p < 0.0001$), self-esteem (compared to U.S. general population standard: z-score: − 9.47, $p < 0.0001$; compared to youth with two chronic conditions: z-score: − 8.02; $p < 0.0001$), and the mental health subscale itself (compared to U.S. general population standard: z-score: − 9.95, $p < 0.0001$; compared to youth with two chronic conditions: z-score: − 7.57; $p < 0.0001$) (Table 4, Fig. 1). TG/GE youth also scored lower than U.S. population standards and youth with two chronic conditions on the role/

**Table 2** Domains of HRQOL assessed by the Short Form-36v2 (SF-36v2)

| Domain | Description |
|---|---|
| Physical functioning | Assesses regular daily activity restrictions due to physical health |
| Role-physical | Assesses frequency of problems with work and regular daily activities due to physical health |
| Bodily pain | Assesses the level of bodily pain experienced and its interference with normal work |
| General health | Assesses self-perceived general health status, health relative to others, and expectations for health in the future |
| Vitality | Assesses energy level and fatigue |
| Social functioning | Assesses the level of disruption caused to normal social activities by health problems |
| Role-emotional | Assesses the frequency of problems with work and regular daily activities due to emotional problems (i.e., depression or anxiety) |
| Mental health | Assesses general mental health, feelings, psychological distress, and well-being |

The SF-36v2 is a 36-item self-report measure of HRQOL consisting of eight subscales. Component summary scores (Mental Component Summary (MCS) and Physical Component Summary (PCS)) can be derived from the mental and physical health subscales, respectively. Scores are transformed to a 0–100 scale (mean: 50; SD: ± 10) with higher scores representing better QOL

**Table 3** Description of the sample ($N = 141$)

| Characteristic[a] | |
|---|---|
| Age at enrollment (years), mean ± SD | 17.1 ± 3.2 |
| Age (years) at clinic presentation, mean ± SD | 16.3 ± 3.2 |
| Assigned sex at birth | |
| Male | 40 (28.6) |
| Female | 100 (71.4) |
| Gender identity | |
| Transmasculine spectrum | 95 (67.4) |
| Transfeminine spectrum | 37 (26.2) |
| Non-binary/gender nonconforming | 9 (6.4) |
| Race | |
| White | 122 (91.7) |
| Black or African American | 4 (3.0) |
| Asian or Pacific Islander | 1 (0.8) |
| More than one race | 6 (4.5) |
| Ethnicity | |
| Hispanic or latino | 9 (7.1) |
| Non-hispanic or latino | 117 (92.9) |
| Education level—youth in school | |
| Elementary | 4 (5.8) |
| Middle | 14 (20.3) |
| High | 51 (73.9) |
| Education level—youth out of school | |
| Homeschooled | 2 (3.3) |
| Taking time off | 1 (1.6) |
| Formally withdrew (No Diploma) | 1 (1.6) |
| High school diploma or equivalent | 17 (27.9) |
| Pursuing higher education | 40 (62.6) |

[a]Table values are mean ± SD for continuous variables and *n* (column %) for categorical variables; numbers may not sum to totals due to missing data; column percentages may not sum to 100% due to rounding

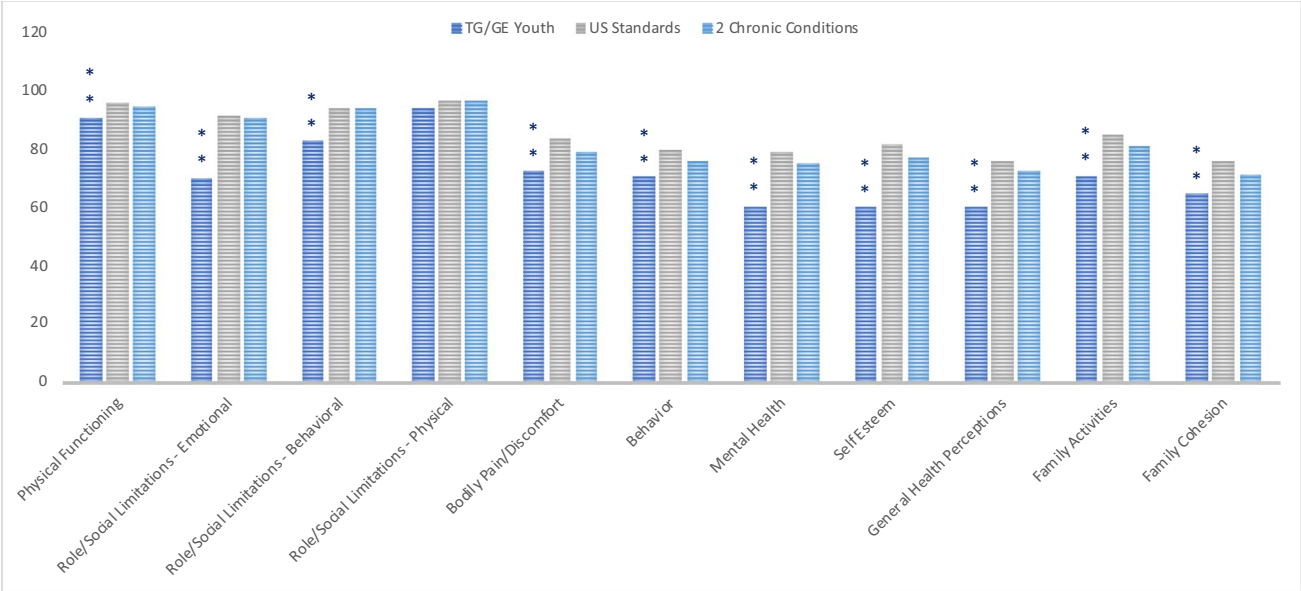
**Table 4** CHQ-CF87 scores for TG/GE youth (ages 8–17) compared to U.S. population standardized scores & youth with two chronic conditions ($N = 74$)

| Subscale | TG/GE youth Mean (SD) | Z-score (vs U.S. Standards)[a] | Z-score (vs two chronic conditions)[b] |
|---|---|---|---|
| Physical functioning | 90.71 (12.85) | −3.60* | −2.55* |
| Role/social limitations—emotional | 69.41 (33.93) | −8.94* | −9.56* |
| Role/social limitations—behavioral | 82.80 (30.60) | −5.20* | −6.18* |
| Role/social limitations—physical | 93.46 (14.20) | −1.70 | −1.84 |
| Bodily pain/discomfort | 72.16 (25.12) | −4.59* | −2.52* |
| Behavior | 70.52 (14.28) | −4.60* | −2.40* |
| Mental health | 60.33 (19.87) | −9.95* | −7.57* |
| Self-esteem | 59.94 (20.67) | −9.47* | −8.02* |
| General health perceptions | 60.32 (17.98) | −7.86* | −6.17* |
| Family activities | 70.09 (23.84) | −5.76* | −3.79* |
| Family cohesion | 64.86 (26.36) | −3.70* | −2.22* |

[a]2015-2016 age-matched (8–18) U.S. standards were utilized for comparison

[b]2015-2016 U.S. standards for youth with two chronic conditions were utilized for comparison

*Z-scores greater than 1.96 or less than −1.96 indicate statistical significance at $\alpha = 0.05$




**Denotes a statistically significant difference from the 2015-2016 U.S. General Population mean subscale score and mean subscale score for youth with two chronic conditions

**Fig. 1** CHQ-CF87 Mean Scores of TG/GE Youth Compared to 2015–2016 U.S. Standards and Youth with two Chronic Conditions ($N=74$)

social limitations—physical subscale, but these differences did not meet the threshold of statistical significance.

## Short Form-36v2 (SF-36v2)

Older TG/GE youth (ages 18–21) scored significantly higher than 2009 U.S. population means (which include adults ages 18–65), on all four of the physical health subscales (physical functioning, physical role, bodily pain, and general health). The resulting physical component summary (PCS) mean was higher than the comparative standard (TG/GE PCS mean: $58.19 \pm 6.92$ vs norm PCS mean: $50.00 \pm 10.0$; $p < 0.0001$) (Table 5, Fig. 2). In age-stratified analysis, the mean subscale score for physical functioning among TG/GE youth did not differ significantly from youth ages 18–24. Age-stratified population data were not available for the other physical health subscales or the PCS.

Despite high physical and general health scores, nearly half of youth reported feeling depressed some or most of the time. The mean scores on three of the four mental

**Table 5** SF-36v2 scores for TG/GE youth (ages 18–21) compared to 2009 U.S. general population standards ($N=67$)

| Scale | Mean (SD) | Comparison to 2009 U.S. general population standards | | | |
|---|---|---|---|---|---|
| | | Well below norm n (%) | Below norm n (%) | At or above norm n (%) | *p* value* |
| Physical | | | | | |
| Physical functioning | 54.76 (4.68) | 2 (2.99) | 3 (4.48) | 62 (92.54) | < 0.001 |
| Physical role | 54.13 (5.11) | 2 (2.99) | 2 (2.99) | 62 (92.54) | < 0.001 |
| Bodily pain | 54.53 (7.28) | 5 (7.46) | 4 (5.97) | 57 (85.07) | < 0.001 |
| General health | 53.00 (9.70) | 10 (14.93) | 4 (5.97) | 53 (79.10) | 0.014 |
| Mental | | | | | |
| Vitality | 49.45 (9.95) | 8 (11.94) | 10 (14.93) | 48 (71.64) | 0.654 |
| Social functioning | 46.63 (10.55) | 14 (20.90) | 10 (14.93) | 42 (62.69) | 0.012 |
| Mental health | 44.66 (9.82) | 17 (25.37) | 13 (19.40) | 36 (53.73) | < 0.001 |
| Emotional role | 43.98 (11.40) | 24 (35.82) | 8 (11.94) | 34 (50.75) | < 0.001 |
| Component summary | | | | | |
| Physical (PCS) | 58.19 (6.92) | 2 (2.99) | 1 (1.49) | 63 (94.03) | < 0.001 |
| Mental (MCS) | 41.60 (12.76) | 27 (40.30) | 5 (7.46) | 34 (50.75) | < 0.001 |

**p* value is for two-tailed *t* test; comparison to 2009 U.S. General Population standards (mean: 50; SD: 10)

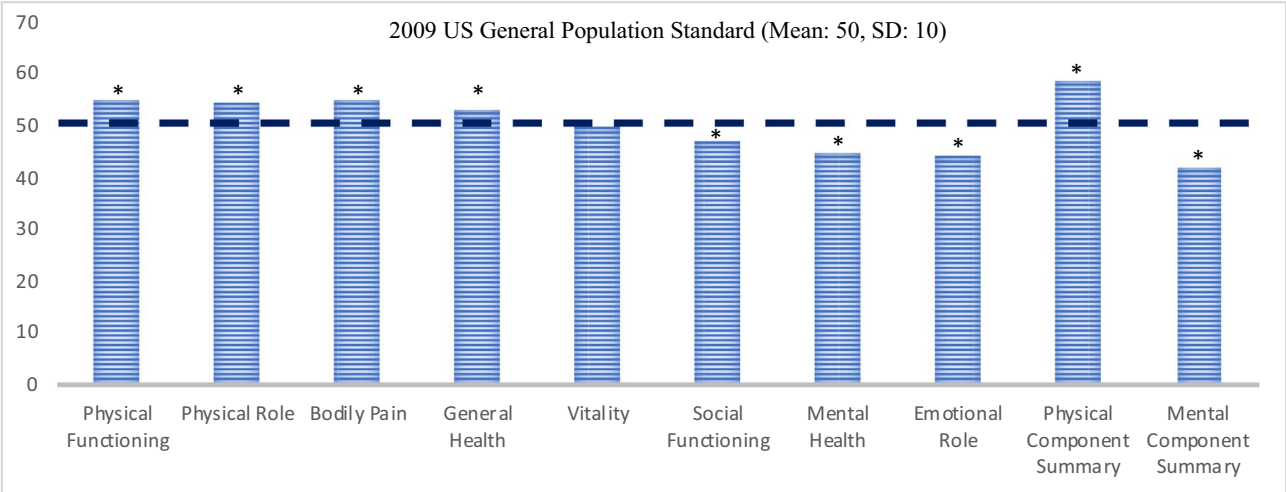



**Fig. 2** SF-36v2 mean scores of TG/GE youth compared to 2009 U.S. general population ($N = 67$)

health subscales were significantly lower than 2009 U.S. population means for the domains of social functioning ($p = 0.012$), mental health ($p < 0.001$), and emotional role limitations ($p = 0.001$). The mental component subscale (MCS) (mean = 41.60) was also significantly lower than the U.S. population mean (mean = 50.00 ± 10.0; $p < 0.001$) (Table 5). Mean scores on the mental health subscale and MCS were also significantly lower among TG/GE youth compared to age-matched population standards (youth ages 18–24) in age-stratified analysis (mental health: $p = 0.007$; MCS: $p < 0.0001$). Age-stratified population data were not available for other mental health subscales.

## Discussion

This cross-sectional study presents results of the baseline HRQOL assessment of 141 TG/GE patients enrolled in a pediatric patient registry at a rural gender clinic. We found that TG/GE youth (ages 8–17) who completed the CHQ-CF87 scored significantly lower than 2015–2016 U.S. population standards and youth with two chronic conditions on all but one subscale. The greatest disparities between TG/GE youth and the comparative U.S. standards were observed on the mental health subscales. Youth who completed the SF-36v2 (ages 18–21) scored significantly higher than 2009 U.S. population standards on physical health scales and lower on mental health scales including social functioning, emotional role, mental health, and the summary component.

These results show discriminative validity of both the CHQ-CF87 and SF-36v2 at the subscale level between our study population and U.S. national standards, and corroborate the findings of two of the studies previously published on HRQOL among TG youth. Zou et al. evaluated HRQOL of TGN patients in the U.S. using similar methods in a clinic-derived sample of youth from approximately the same age range as this study's sample [4]. Zou et al. [4] documented diminished HRQOL among TGN youth compared to healthy controls and compared to all but two chronic disease groups. HRQOL scores were similarly lower among TG/GE youth in our sample on both the CHQ-CF87 and SF-36v2 relative to healthy controls. We also document diminished scores among TG/GE youth on the psychosocial subscales evaluated by both the CHQ-CF87 (role/social limitations-emotional, self-esteem, and mental health) and the SF-36v2 (including social functioning, emotional role, mental health, and the MCS).

Roder et al. showed similar results in terms of diminished HRQOL in a clinic-derived sample relative to age-matched reference standards [5]. Roder et al. [5] found that social support, peer, and school components of QOL were lower in their sample compared to the reference norm. The cross-sectional study identified high levels of internalizing problems and low levels of body satisfaction that were significantly associated with diminished HRQOL. Our study did not evaluate social support, peer relations, or the school environment, and our analysis did not include testing associations between demographic or clinical variables and HRQOL, therefore, we cannot compare our results with these aspects of the Roder et al. [5] study.

A longitudinal study by De Vries et al. found that QOL scores for TG youth who had undergone "gender reassignment" (defined as puberty suppression, followed by hormone therapy and gender-affirming surgery) were not significantly different from the comparison samples (with the exception

of the environment domain) [6]. TG youth actually scored higher on the environment domain compared to the Dutch population standard, indicating that TG youth in the sample reported a high level of access to health and social care as well as safety and security. These results suggest that gender-affirming medical care of TG youth involving puberty suppression, hormone therapy, and gender-affirming surgery alleviates gender dysphoria and improves psychological functioning and QOL. These results may not be generalizable to U.S. populations, however, where TG youth face barriers to accessing gender-affirming care and may receive less support and face greater stigma and discrimination than reported by this sample of youth from the Netherlands.

To the best of our knowledge, our study is the first to evaluate HRQOL among TG/GE youth in a rural clinic setting. Few papers have been published to date documenting the experiences and health needs of rural TG/GE persons. Our mental health subscale findings underscore the dire need for mental health services for TG/GE youth in rural areas. Our study demonstrates that health disparities affecting clinical care in rural areas [29] likely amplify the HRQOL differential that TG/GE populations face, so much so that their HRQOL scores equate to those youth with two chronic conditions. The relative isolation of rural areas compared to urban areas is also likely to exacerbate any mental health problems. While stigmatization affects TG/GE youth in both rural and urban areas, it is likely that there are more social supports and mental health resources in urban than rural areas. We did not directly measure social support or access to mental health in this study, so this topic remains an area for future research.

Rural TG research subjects are frequently grouped together with sexual minority persons in combined lesbian, gay, bisexual, and transgender (LGBT) study populations [40]. Rural LGBT health research has been largely limited to cross-sectional surveys with small sample sizes and qualitative studies [40]. A systematic review of health and healthcare of rural sexual and gender minorities conducted by Rosenkrantz et al. revealed a small number of studies published on the topic (58 total studies were included in the literature synthesis) [40]. The included studies described health disparities affecting rural LGBT individuals including substance use (i.e., high prevalence of current and former tobacco use), sexual risk-taking behaviors (i.e., sexual activity while under the influence of alcohol and/or drugs), and mental health (i.e., higher rates of depression found in rural LBGT adults compared to urban counterparts and high prevalence of lifetime suicidal ideation among rural TG persons). Very few studies ($n = 9$) evaluated physical health among rural LGBT persons, with most subjects reporting overall good or very good health. Nineteen of the included studies directly compared health outcomes and risk factors of rural vs. non-rural LGBT subjects, and the results were mixed.

The Rosenkrantz 2016 review also examined sociocultural factors at the intersection of rurality and health. Included articles documented limited rural provider education regarding LGBT populations, negative LGBT bias present at individual and institutional levels, and significant barriers to healthcare access for LGBT individuals (i.e., health insurance coverage and discrimination in insurance policies, financial barriers), transportation and geographical barriers, and lack of healthcare options in rural areas. Discrimination was present not only within the healthcare system but also in rural communities. A number of studies included in this review documented generalized social stigma and associated discrimination, lack of social support, low levels of social engagement, and isolation affecting LGBT persons in rural settings. The results of the systematic review indicate that critical gaps remain in the extant literature on rural LGBT persons and the impact of rural residence on health outcomes. Our study of HRQOL among TG/GE youth at a rural gender clinic is an important contribution to the literature base. Although barriers for TG adults have been documented [41], we are unable to comment at this time on specific disparities, barriers to care, or conditions of rural life affecting TG/GE youth in our study population that may have contributed to diminished HRQOL. These questions will be the subject of future research studies utilizing data collected prospectively in the GWC registry.

## Limitations & future research directions

Like numerous other HRQOL studies, this study was cross-sectional in design and provides a snapshot of HRQOL at a particular moment in time (registry enrollment). Cross-sectional studies lack the element of temporality and as such, we cannot draw any conclusions about how HRQOL changes over time, particularly with exposure to gender-affirming healthcare. To address this particular limitation and enable longitudinal examination of the registry population, HRQOL assessments will be repeated on a biennial basis and a longitudinal assessment of HRQOL as a function of exposure to gender-affirming care will be explored as a future study.

Additionally, the CHQ-CF87 and SF-36v2 are generic HRQOL measures. A questionnaire specifically designed to measure HRQOL among TG/GE youth, and which measures the impact of minority stress, discrimination, and other factors known to influence HRQOL, would have been preferable to utilizing generic assessments. However, to our knowledge, a validated, substantive, and gender-affirming TG-specific HRQOL survey does not exist, and represents another major limitation of the extant TG HRQOL literature. To address this particular limitation, we are gathering contextual information about social and environmental factors that could potentially influence HRQOL by assessing family and school support, exposure to bullying, stigma

and discrimination, and access to and use of mental health services when HRQOL surveys are repeated at 24 months post-registry enrollment.

The CHQ-CF87 has not previously been used to evaluate HRQOL in TG/GE youth; therefore, we are unable to compare the results from our rural clinic to results from any other population of TG/GE youth (urban or rural). The SF-36v2 has been used broadly including in adult TG samples. Future analyses will explore similarities and differences between HRQOL in our sample and other TG samples in the U.S.

Regarding rural context, U.S. Census data and definitions of rurality put forth by government agencies were used in an effort to objectively classify registry subjects as living in rural or non-rural areas. Utilizing zip codes as a proxy for a rurality measure does not fully capture the nuances of rurality, particularly as they pertain to healthcare, transportation and wireless internet access, support in home communities, and economic, financial, and employment realities of rural life. Our follow-up survey of registry subjects 24 months post-registry enrollment includes questions about these factors in order to capture differences in the experiences of rural vs. non-rural TG/GE youth. In future studies, we plan to explore some of the sociocultural factors at the intersection of rurality and health identified by Rozenkrantz et al. [40] that may contribute to diminished HRQOL among rural TG/GE youth.

## Conclusions

Cross-sectional HRQOL data from a rural clinic registry of TG/GE youth indicate significantly poorer mental health measures as compared with the U.S. population standards. Youth < 18 years of age also reported significantly lower physical HRQOL compared to age-matched U.S. standards and youth with two chronic conditions. Longitudinal assessments of HRQOL metrics are needed to ascertain whether reported HRQOL improves with the receipt of gender-affirming healthcare, including mental health services. Future research should compare the physical and mental HRQOL of rural versus urban TG/GE youth in order to identify modifiable factors affecting HRQOL such as access to healthcare, social support, and school environment.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** Study procedures were approved by the Mary Imogene Bassett Hospital Institutional Review Board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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